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ABSTRACT

The objectives of this study were to collect and summarize data on students enrolled in a three course sequence of calculus at Valencia Community College, and to describe the educational goals of these students. Specifically, the study sought information about the success rate, previous college mathematics, and scores on a standardized test of students enrolled in the calculus sequence. Results include an increase in enrollments in calculus over a three-year period, with smaller enrollment figures in the two higher courses and almost 50% of the students pursuing preprofessional or business fields. (MP)

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A REPORT ON

STUDENTS IN CALCULUS

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A Survey of the Background and Success of Students Taking Calculus at Valencia Community College 1971 - 1974

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Introcudtion

The desire to know what has been done in the past in order to develop insight to the future has prompted much research. In planning instructional programs those responsible must maintain constant scrutiny at existing courses, students placed in or selecting those courses and the student goals being met by those courses. Craig Johnson states that curricular review should be a regular process.[1] If the regular changes being made in curriculum are to be evaluated and understood, knowledge of the recent past will prove invaluable. The person responsible for the changes needs help from survey research to aid in the decision making proess.

At Valencia a major change was made in the three-course sequence in mathematics: Calculus with Analytic Geometry MS 251-252-253. In the Fall of 1974 the credit hours in this sequence was changed from four hours each to a 5-5-3 pattern. The textbook for the course was also changed from the Protter and Morrey Calculus/Analytic Geometry to the Louis Leithold The Calculus with Analytic Geometry, Part I.

The major reason given for the change in credit hours was to allow students taking only the first course to have experience with both differentiation and integration. The second course may then give a more complete treatment of integral techniques and applications to real problems. More students

[1]Dressel, et al Institutional Research in the University Jossey-Bass, Inc. 1971 p.137.

are now being told to take calculus for their upper division majors (e.g. business majors) but they may stop with only one or two of the courses but not all three. This change will permit the student to study more topics in the course(s) he takes.

To evaluate these accepted changes some vital information would be needed (1) of the demographic information of the students who have been in the calculus courses previous to the change, (2) what success the students were experiencing in the courses and (3) what career goals these students were pursueing. The information revealed by this survey will serve as a benchmark to which future studies may be compared.

This study was, in part, motivated by discussion with Dr. Ronald Evans of the College of Engineering at Florida Technological University. He had inquired concerning comparable information which had been gathered on students in the calculus sequence at FTU. Primarily, he asked what was a typical score for our students on their Florida Twelfth Grade Test Battery (FTG) and did the failure rate continue at the same level for our sequence of calculus courses?

Objectives

The specific goals and objectives of the study were as follows:

1. To collect data on the students who have been enrolled in the MS 251 classes for three years and summarize

this information:

a. to learn what ratio of students completed the course with a grade of D or better

b. to find what ratio of students had previously taken courses in developmental algebra, i.e. MS 80 Elementary Algebra and/or MS 81 Intermediate Algebra

c. to determine what ratio of students had, at college level, separate courses in college algebra and/or trigonometry as comapred to a combined course

d. to calculate the mean and median FTG scores of the students in these classes.

2. To collect information on the students who have been enrolled in MS 252 and 253 classes for three years:

a. to learn the ratio of students completing the courses with credit

b. to calculate the mean and median FTG scores

c. to determine the ratio of students in Calculus II and III that had taken Calculus I at Valencia and compare grades in the courses

d. to determine the ratio of students completing Calculus III that took, at Valencia, separate courses in college algebra and/or a developmental algebra course.

3. To describe the educational goals and other information of these students.

Procedures

The sequence (section) number of each calculus class offered since Fall 1971 was selected from past schedules and copies of the final grade reports were secured from the Registrar's Office. Individual permanent records of each student were examined and desired demographic information

recorded for analysis. Student questionnaires completed by students in Session II of 1973-74 were used to find information on career goals, work loads and credit hour loads.

Results for Calculus I

The results for the tabulations of the Calculus I classes are shown in tables 1,2,6,7 and 8. Specifically, tables 1 and 2 show a composite picture for the three years showing numbers enrolled and the average size of the sections. Tables 6, 7 and 8 show breakdown by section of the annual picture. Attention is called to several facts on table 2 concerning the results in MS 251. Night sections do not normally register as many students per class as day classes. Sixty-four percent (64%) of the students who were enrolled completed the course with credit. As the breakdown by sections in tables 6,7 and 8 will show, the percent receiving credit appears to be nearly stable from year to year. It should be noted that the percent of completion was greater for day students than for night students for two of the three years. Less information is available for night students. Most of the students (76%) started their mathematics program at Valencia with developmental algebra courses (19%) or separate courses of college algebra and trigonometry (57%). This illustrates the fact that Valencia is largely serving the student that did not make a strong preparation for college mathematics while in high school. The FTG scores of these students indicate a very wide range of aptitude. The

Table 1

Number of sections and enrollment totals.

Year	MS 251	MS 252	MS 253
71-72	5 - 70	3 - 34	2 - 14
72-73	6 - 109	3 - 43	1 - 10
73-74	6 - 114	4 - 56	1 - 13
	17 - 293	10 - 133	4 - 37
Average size per section:	17.2	13.3	9.3

Table 2

Summary of MS 251 1971 -74

	Total	Day	Night
Number of Sections	17	10	7
Enrollment	293	181	112

Final Grades:	A	B	C	D	Total Credit	F	I	N	W	Total
freq.	27	59	86	17	189	1	17	5	81	293
%	9	20	29	6	*	-	6	2	28	

* 189/293 or 64% received credit

Background Courses	MS 81*	170/171*	173	Total*
# taking separate course	57	166	53	219
%	19	57	18	

Note: *Many students have no record of previous courses. Those taking MS 81 went on to take separate courses in 170 and 171.

Aptitude

FTG scores on 164 students range: 119 - 495
mean score 365 median: 366

σ = 77.6

Night sections: 7 sections

Of 112 students only 39 had FTG scores in their file.
(Many students with no records - either transient or special, some with 4 yr. degrees previously)

Continuation:

Of 189 receiving credit in MS 251, 90 continued,

67 to receive credit in MS 252, Calculus II, as of July 1, 1974.

(others are expected to continue in Fall, 1974.)

average (mean) score of365 would place a student in about the 75% in his senior class, surprisingly low for calculus students since less than ten percent of a high school senior class takes mathematics beyond geometry.

Results for Calculus II

Tables 3 and 4 report the information on Calculus II classes, showing enrollment, grades received, percent of students receiving credit in the course, background courses taken, and aptitude indicated by FTG scores. From this information it appears that the total percent receiving credit remained somewhat stable from year to year, although night classes were more irregular. The FTG scores for this group which attempted a second course in calculus exhibited higher aptitude than the group attempting calculus in the first course. The mean score for the forty percent who had them in their records was 391. It may be noteworthy that over 50% of these students started their college mathematics program with either a developmental algebra course or a separate course in college algebra.

Results for Calculus III

Table 5 presents results for the Calculus III classes. Of this group 92% received credit which may indicate that

Table 3

Summary of MS 252 1971-74

	Total	Day	Night
Number of Sections	10	7	3
Enrollment	133	104	29

Final Grades:

Sequence #	#	A	B	C	D	Credit	F	I	N	W	
1971-72											
816	13	4	3	2	1	10	.	.	.	3	
808	13	.	4	3	1	8	.	.	.	5	25/34
809(N)	8	1	2	3	1	7	.	.	.	1	74% received credit*
Total	34	5	9	8	3	25	.	.	.	9	
*Night was 87%; day 69%											
1972-73											
2302	15	1	3	7	.	11	.	.	.	4	
2428	17	.	5	6	1	12	.	.	.	5	29/43
2429(N)	11	2	2	2	.	6	.	.	1	4	68% received credit*
Total	43	3	10	15	1	29	.	.	1	13	
*Night was 54%; day 71%											
1973-74											
3061	19	2	5	6	1	14	.	.	.	5	
3041	12	1	3	4	1	9	.	.	.	3	
3042(N)	10	3	.	2	.	5	.	.	.	5	39/56
2451	15	3	5	3	.	11	.	.	1	3	70% received credit*
Total	56	9	13	15	2	39	.	.	1	16	
*Night was 50%; day 74%											
Summary 71 - 74											
#	133	17	32	38	6	93	.	.	2	38	
%		13	24	29	5	70%	.	.	1	29	

Table 4

MS 252 Background and Aptitude

133 Students in all 10 sections

FTG

52 Students has scores on file

Range	Mean	Median
203-495	377	391

Developmental Courses

Course	80/81	170/171	173	251
freq.	17	54	17	11
%	13	41	13	8

(no records for 25%)

more of those making it into the course were equipped to satisfactorily complete the course. These results also indicate that two-thirds of this group had the same or higher grade in Calculus III as in their earlier calculus course.

Questionnaire Results

The items on the student questionnaire which were of interest revealed the following information about career plans, work loads and credit hour load. This information was available for only one section of Calculus I from Session II, 1973 - 74.

1. 20 students were enrolled in this section and 18 completed the questionnaire. For grades and background information on this section see table 8 sequence #3037. This day class was typically a group coming directly from local high schools.

2. The typical credit hour load for which these students were registered was 14.

Load(hrs.)	7	11	13	14	16	17	18	19
freq.	1	1	1	6	1	2	2	2

3. Career plans: Most students had a specific career or major field indicated, however three were not certain.

Career	Type A Engineer Computer Sci. Mathematics	Type B Science, Gen. Chemistry Biology Meteorology	Type C Pre-law Pre-med. Pre-vet. Pre-pharm.	Type D Business (CPA) Others
freq.	3 (+3)*	4 (+3)*	5	3

* three undecided between these areas

Table 5

Summary of MS 253 1971-74

	Total	Day	Night
Number of Sections	4	4	0
Enrollment	37	37	0

Final Grades

Sequence #	#	A	B	C	D	credit	F	I	N	W	
1971-72											
811	8	1	3	4	.	8	.	.	.	.	
455	6	.	1	5	.	6	.	.	.	.	
1972-73											
2434	10	.	3	4	2	9	.	.	.	1	34/37 92% received credi
1973-74											
3047	13	3	3	3	2	11	.	.	.	2	
Totals	37	4	10	16	4	34	.	.	.	3	

Background: FTG

14 with FTG scores-mean 398

Of 37 There were 33 who had calculus III at Valencia Community College; of these 22 had same or higher grade. There were 20 who had all three I, II, and III at Valencia Community College.
14 show credit in separate courses in college algebra and trigonometry while 11 received credit in a combined course.

4. Work loads for these students may come as a surprise when we consider the credit hour load carried. Nine students (half) worked 20 - 30 hours per week, however, of the seven not working six were planning to work if a suitable job could be found.

hrs/wk	8-10	20-30	50
freq.	1	7	1

Conclusions and Recommendations

From this survey we note that enrollments in calculus have shown an increase throughout this three year period, with smaller enrollment figures in the two higher courses. The ratio of the students receiving credit in MS 251 was 64%, in MS 252 it was 70% and in MS 253 it was 92%. There was more consistency in the results for the daytime classes.

The ratio of students taking a developmental course in algebra at college was about one in five, indicating these students came without recent background or no mathematics of the pre-calculus type in high school. The students who began the calculus sequence included some with very low FTG scores, a few of whom did successfully complete both MS 251 and MS 252.

Of the eighteen students responding to the questionnaire about half were pursueing science or mathematics-oriented degree programs, while eight were pre-professional or business

oriented. This should alert the instructor to keep in mind the use of other applications beside the usual engineering type found in most textbooks.

It is recommended that similar information be gathered on the calculus students who will be taking the courses with the new credit hour arrangement and the new textbook and compared to information in this report. It is further hoped that a more suitable arrangement can be completed to have this information about credit hours, grades and FTG scores placed on student files available on the computer so that every individual record doesn't have to be examined in detail by hand methods.

APPENDICES

Table 6

Analysis of MS 251 by section for 1971 - 72

Year 1971 - 72 5 sections: day 3 night 2
70 enrolled: day 42 night 28

Final Grades

Sequence #	Enroll	A	B	C	D	credit	F	I	N	W
804	17	.	4	6	.	10	.	.	.	7
805	8	2	1	2	.	5	.	1	.	2
806(N)	16	2	1	3	.	6	.	.	1	9
813	17	.	5	8	.	13	.	.	1	3
814(N)	12	1	.	6	1	8	.	.	2	2
Totals	70	5	11	25	1	42	0	1	4	23

42/70 or 60% received credit*

*Night was 50%; day 67%

Sequence #	#	FTG Range	FTG Mean	FTG Median	Previous Courses MS 81	Previous Courses 170/171	Previous Courses 173
804	10	303-439	370	363	3	10	7
805	7	357-471	391	365	2	4	3
806(N)	5	387-452	418	425	1	8	4
813	12	127-446	343	359	5	13	1
814(N)	1	395	395	395	3	10	0
Totals	35	127-471	372	365	14	45	15
	only 50% with FTG scores				20%	64% of 70	21%

Table 7

Analysis of MS 251 by section for 1972-73

Year 1972 - 73 — 6 sections: day 3, night 3; 109 enrolled: day 58, night 51

Final Grades

Sequence #	Enroll	A	B	C	D	credit	F	I	N	W
1910	7	1	2	1	1	5	1	.	.	1
2003(N)	20	.	1	2	1	4	.	7	.	9
2422	25	2	6	8	2	18	.	.	.	7
2423(N)	13	.	2	2	2	6	.	.	.	7
2296	26	1	3	13	2	19	.	.	.	7
2298(N)	18	5	5	3	.	13	.	.	.	5
totals	109	9	19	29	8	65	1	7	0	36

$\frac{65}{109}$ or 60% received credit*

*Night was 45%; day 72%

Sequence #	#	FTG Range	FTG Mean	FTG Median	Previous Courses MS 81	Previous Courses 170/171	Previous Courses 173
1910	1	229	229	229	1	3	.
2003(N)	8	203-407	332	361	1	11	2
2422	22	119-495	397	423	3	12	9
2423(N)	8	265-458	393	401	1	6	1
2296	15	193-476	362	368	8	16	2
2298(N)	9	330-458	403	417	1	6	4
totals	63	119-495	378	392	15	54	18
	only 58% with FTG scores				14%	50% of 109	17%

Table 8

Analysis of MS 251 by section for 1973 - 74

Year 1973-74 — 6 sections: day 4 night 2; 114 enrolled: day 81 night 33

Final Grades

Sequence #	Enroll	A	B	C	D	Credit	F	I	N	W
2448	13	2	1	4	1	8	.	1	.	4
3035	23	3	10	4	.	17	.	2	1	3
3036(N)	20	3	5	7	1	16	.	2	.	2
3037	20	2	6	4	3	15	.	.	.	5
3055	25	.	4	10	3	17	.	.	.	8
3056(N)	13	3	3	3	0	9	.	4	.	.
Totals	114	13	29	32	8	82	.	9	1	22

$\frac{82}{114}$ or 72% received credit*

*Night was 75%; day 70%

Sequence #	FTG #	FTG Range	FTG Mean	FTG Median	Previous Course MS 81	Previous Course 170/171	Previous Course 173
2448	9	206-436	350	380	3	10	2
3035	15	206-472	328	328	9	13	11
3036(N)	5	237-380	309	303	4	13	2
3037	16	302-463	377	366	2	9	3
3055	18	119-484	344	363	6	16	1
3056(N)	3	249-460	383	441	4	6	1
Totals	66	119-484	350	364	28	67	20
	only 58% with FTG scores				25%	59% of 114	18%